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(Charadriiformes) in Subarctic Seas

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***Pseudogymnophallus alcae* gen. n. et sp. n.**
(Trematoda: Gymnophallidae) from Alcids
(Charadriiformes) in Subarctic Seas

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ABSTRACT: *Pseudogymnophallus alcae* gen. n. et sp. n. is described for trematodes from alcids (Charadriiformes: Alcidae) from the North Pacific region (Gulf of Alaska, Bering Sea, and Chukchi Sea): horned puffin, *Fratercula corniculata*; tufted puffin, *Lunda cirrhata*; parakeet auklet, *Cyclorhynchus psittacula*; and least auklet, *Aethia pusilla*; and from the western North Atlantic Ocean, (Gulf of St. Lawrence): razorbill, *Alca torda*. *Pseudogymnophallus* is distinguished from other genera of Gymnophallidae by the intertesticular position of the ovary; a cylindrical, undivided seminal vesicle; and by an intestinal diverticulum dorsal to the arch of each cecum.

A trematode species representing a previously unrecognized genus of Gymnophallidae has been collected from puffins, *Fratercula corniculata* and *Lunda cirrhata*, in the Gulf of Alaska, Bering Sea, and Chukchi Sea. The species was recovered less frequently from the parakeet auklet, *Cyclorhynchus psittacula* and the least auklet, *Aethia pusilla* from St. Lawrence Island and St. Paul Island, Alaska, and the razorbill, *Alca torda* from St. Mary's Islands, Quebec, in the western North Atlantic. The only previous record of gymnophallids from an alcid host is that of *Gymnophallus deliciosus* (Olsson, 1893), a common parasite of gulls (Laridae); Belopol'skaia (1952) reported that species from puffins, *Fratercula arctica* in the Barents Sea.

Trematodes from puffins examined in the field at Ugaiushak and Kodiak Islands, Gulf of Alaska, were fixed in buffered 10% formalin at 85°C and prepared as whole mounts stained in Semichon's acetic carmine. Colleagues provided additional mounted and preserved specimens from puffins and auklets in Alaska and razorbills in Quebec; 10 from puffins at Cape Thompson, Alaska, were prepared as sagittal sections. All measurements are in micrometers and are given as ranges. Only those for eggs are followed by mean values with standard errors. The following description is based on measurements from 75 trematodes (16 from Cape Thompson; 23 from St. Lawrence Island; and 36 from Ugaiushak Island). In some, the egg-filled uterus made it impossible to measure all organs. Specimens from *Alca torda* and *Aethia pusilla* were not used in preparing the description due to their poor state of preservation.

***Pseudogymnophallus* gen. n.**

DIAGNOSIS: Gymnophallidae: Gymnophallinae. Body small, oval to pyriform, spinose. Oral sucker subterminal, without lateral papillae. Prepharynx absent. Pharynx small, esophagus short. Ceca long, extending into posterior third of body; arch of each cecum with dorsal diverticulum. Acetabulum in middle third of body; smaller than oral sucker. Testes smooth, symmetrical or slightly diagonal, lateral to acetabulum. Cirrus pouch absent. Seminal vesicle cylindrical to weakly bipartite. Pars prostatica followed by very short ejaculatory duct. Genital pore median, on anterior margin of acetabulum. Ventral pit absent. Ovary

smooth, submedian, intertesticular, in middle third of body posterior to acetabulum. Seminal receptacle absent. Laurer's canal present. Vitelline follicles in a pair of submedian groups anterolateral to acetabulum. Uterus voluminous, sometimes filling body posterior to pharynx. Excretory vesicle Y-shaped, with arms reaching pharyngeal level. Parasitic in gall bladder and intestine of birds (Charadriiformes: Alcidae).

TYPE AND ONLY SPECIES: *Pseudogymnophallus alcae* sp. n.

***Pseudogymnophallus alcae* sp. n.**
(Figs. 1–5)

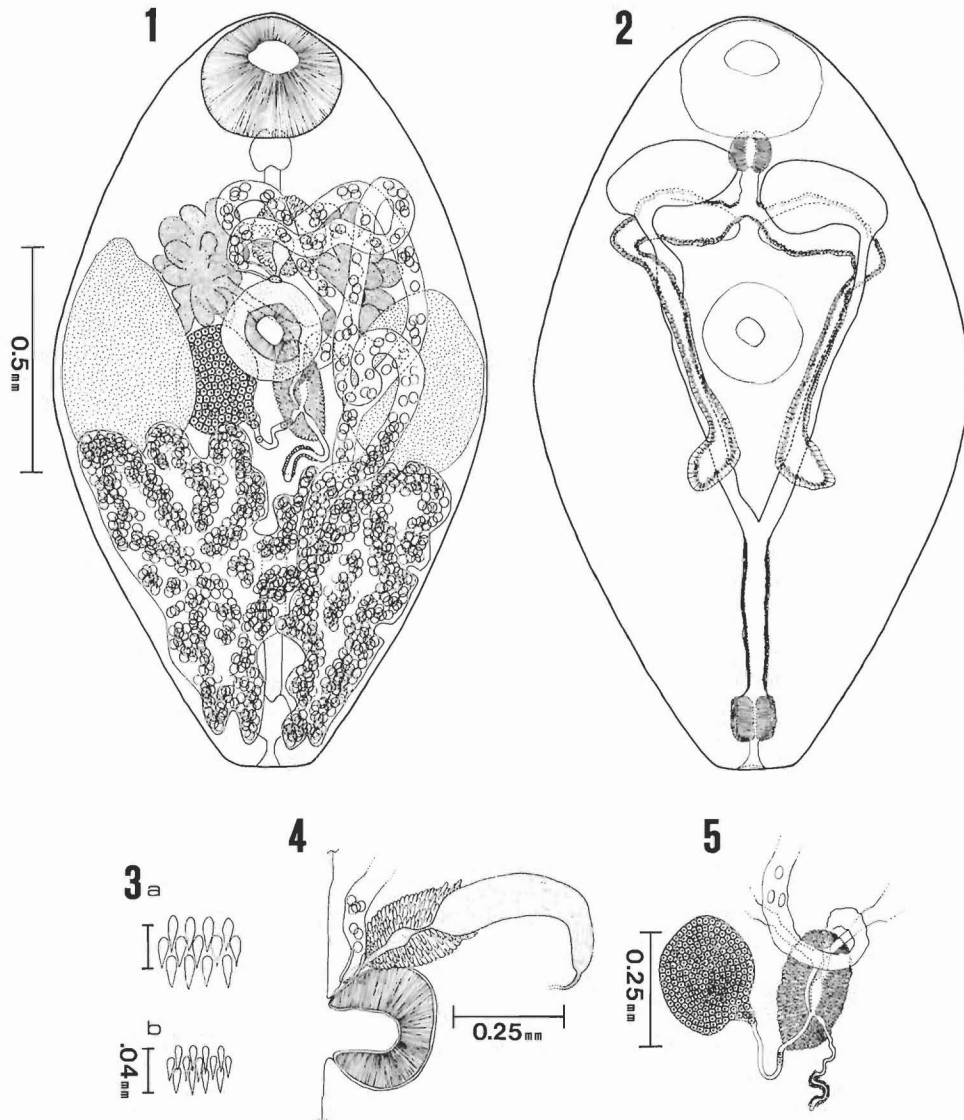
DESCRIPTION: With characteristics of the genus. Body, 967–2,780 long by 642–1,611 in maximum width. Entire tegument with alternating transverse rows of scalelike spines, 7–32 long by 1–9 wide at base, generally larger toward posterior end of body. Oral sucker, 236–389 in diameter; acetabulum 153–295. Ratio of transverse diameter of oral sucker to acetabulum 1:0.58–0.95. Pharynx cylindrical, 61–139 long by 58–124 wide. Esophagus 58–145 long, often convoluted. From inflated arches, ceca narrow to turn ventromedial, pass between testes and terminate near their posterior margins. Ceca lined with single layer of large glandular cells from level of bifurcation. Diverticulum of each cecum 159–203 long by 116–117 wide, extending dorsomedial from arch nearly to bifurcation. Genital atrium shallow, wider than pore. Testes ovoid, 247–778 long by 177–554 wide; near side of body in middle third. Prostatic cells and vesicle conspicuous, their combined mass 128–283 long by 122–232 wide. Seminal vesicle 272–551 long by 101–130 in diameter curving dorsad to dorsoposteriad from prostatic vesicle. Ovary ovoid, 141–342 long by 118–307 wide; dorsal, intertesticular, sinistral, dextral, or seldom median; slightly posterior to or overlapping acetabulum and median margin of testis. Mehlis' gland median, ventral to ovary, 145–227 long by 87–145 wide. Vitellaria with 13–30 follicles in each group, dorsal and anterolateral to acetabulum. Vitelline ducts extending posteroventrad to unite and join ootype ventrally. Oviduct leaves ovary lateroventrally. Laurer's canal often convoluted extending posterodorsad from oviduct to open middorsally. Uterus extending anteriorly from ootype in a slightly convoluted loop as far as cecal bifurcation, then posteriorly in descending and ascending loops filling posterior $\frac{2}{3}$ of body. Metraterm 15–43 in diameter, approaching genital atrium sinistrally or dextrally. Eggs 23–32 long by 15–23 wide ($\bar{x} = 26 \pm 0.18$ by 17 ± 0.10). Excretory vesicle with prominent sphincter near terminus of stem; arms terminating anteriorly in transverse dilations ventral to ceca and flanking esophagus.

HOSTS: Horned puffin, *Fratercula corniculata* (Naumann) (type host); tufted puffin, *Lunda cirrhata* (Pallas); parakeet auklet, *Cyclorhynchus psittacula* (Pallas); least auklet, *Aethia pusilla* (Pallas); and razorbill, *Alca torda* Linnaeus.

SITE: Gall bladder and intestine.

LOCALITIES: Cape Thompson (lat. 68°06'N; long. 165°46'W) (type locality), Ugaiushak, Kodiak, St. Paul and St. Lawrence Islands, Alaska, and St. Mary's Islands, Quebec.

TYPE SPECIMENS: Holotype USNM Helm. Coll. 75935 and Paratype 1, 75936 from a horned puffin collected by L. G. Swartz; Paratypes 2 and 3, 75937 and 75938, from horned and tufted puffin, respectively at Ugaiushak Island; Paratypes



Figures 1–5. *Pseudogymnophallus alcae*. 1. Ventral view showing all organs except the excretory system and ceca. 2. Ventral view showing relationship of the ceca and excretory systems. 3. (a) Tegumental spines of specimens from Ugaiushak Island; (b) tegumental spines of specimens from Cape Thompson. 4. Lateral view of the genital pore, showing metraterm, and position of prostatic and seminal vesicles. 5. Ventral view of female genital system: ovary, Mehlis' gland, and associated ducts including the ovarian duct, vitelline ducts, Laurer's canal, and ascending uterus.

4 and 5, 75939 from a parakeet auklet at St. Lawrence Island. In addition a voucher specimen, 76213, from a razorbill was deposited to substantiate the host record. The remaining specimens are retained in the collection of the author.

ETYMOLOGY: The specific name *alcae* is derived from the Swedish and Icelandic *alka* signifying auk, a general name for members of the family Alcidae.

Discussion

Pseudogymnophallus gen. n. differs from all other genera of Gymnophallidae in having relatively long ceca with diverticula, an intertesticular ovary (pretesticular in other genera), and a cylindrical seminal vesicle (bipartite or club-shaped). It is most similar to *Gymnophallus* Odhner, 1900, in general body size, position of the genital pore, arrangement of vitelline follicles, and extent of uterus. It can be distinguished further from *Lacunovermis* Ching, 1965, and *Gymnophalloides* Fujita by Dollfus, 1925, by the absence of a ventral pit anterior to the acetabulum, and from *Parvatrema* Cable, 1953, and *Meiogymnophallus* Ching, 1965, by the absence of lateral papillae on the oral sucker. In addition it differs from *Paragymnophallus* Ching, 1973, in the position and size of the genital pore. *Pseudogymnophallus* appears to be restricted to birds of the family Alcidae, whereas other genera of Gymnophallidae are known from other groups of Charadriiformes, or from Anseriformes.

The position of the ovary (i.e., relative to the testes and acetabulum) and other morphological attributes which characterize *P. alcae* were constant. The normal habitat of *P. alcae* appears to be the gall bladder, although numerous specimens were found in the intestines of puffins at Ugaiushak. Such specimens were characterized by a patchy loss of spination, and probably represent individuals which had migrated from the gall bladder to the intestine and were in the process of being eliminated from the host. *G. deliciosus* has also been reported from both the intestine and gall bladder of its hosts, which was presumed by Ellis and Williams (1973) to indicate its ability to travel from the gall bladder to the intestine through the bile duct. Although the present specimens were alive when collected, loss of spination suggests that the intestine is not viable habitat for *P. alcae*.

The pattern of tegumental spination was identical for trematodes from different host species. However, spines on specimens from Ugaiushak (Fig. 3a) were broader and more massive than those on specimens from Cape Thompson (Fig. 3b) and St. Lawrence Island (spines had been lost on the specimens from Quebec and consequently could not be compared). This could be an indication of some degree of endemism associated with the Gulf of Alaska and the northern Bering Sea, respectively.

Of life cycles thus far elucidated for gymnophallids, the majority includes two intermediate hosts, both of which are usually intertidal lamellibranchs (Loos-Frank, 1971). Benthic polychaetes have been reported as second intermediate hosts for several species (Loos-Frank, 1969; Margolis, 1971, 1973; Popova and Nikitina, 1978). Most final hosts of these trematodes are species of Charadriiformes, including larids, and Anseriformes (primarily sea ducks) whose foraging occurs in relatively shallow marine littoral areas. A major component of their diets consists of intertidal lamellibranchs, gastropods, and benthic polychaetes.

In contrast the hosts of *P. alcae* are predominately planktonic foragers which exploit macrozooplankton (*Aethia pusilla* and *Cyclorhynchus psittacula*), a mixture of macro- and megazooplankton and nekton, including various species of fishes and squids, and polychaetes (*Lunda cirrhata* and *Fratercula corniculata*) or almost exclusively fishes (*Alca torda*) (Bédard, 1969a, b; Belopol'skii, 1957; Sanger et al., 1978; Swartz, 1966; Wehle, 1976). The prey types expected to serve as intermediate hosts for *P. alcae* either occur rarely or have not been recorded

in the diets of its known final hosts. However, Bédard (1969b) pointed out that zooplanktonic foragers may be particularly limited by prey availability in the winter when the bulk of the zooplankton biomass is beyond the depth range of feeding, thus auklets and puffins may be forced to exploit alternate prey species which could serve as intermediate hosts for *P. alcae*.

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